

INSTALLATION OF SEMICONDUCTOR STRAIN GAGES

ABSTRACT

These instructions establish the procedures for installing Micron Instruments semiconductor strain gages to steel and titanium surfaces.

EPOXY

Micron Instruments recommends Epoxylite™ 6203FF epoxy for affixing the gages to the metal surfaces. This is a high temperature, extreme range adhesive, “stable” to +500°F for short durations. It is a two-part epoxy, consisting of Biphenol A with PDMA as a catalyst. Talc is used as a filler and is mixed with the PDMA as a fine powder. Epoxylite 6203FF is available as a premixed and frozen adhesive and this form is ideal for gaging.

The talc and catalyst have been finely ground, with particle size of 0.1 mil or less, so that lumps are not a problem, although some larger particles usually are found in the powder mixture.

Once the epoxy is mixed, it begins to cure, even at temperatures as low as -40°F. At temperatures of -40°F or less, it has been determined that the useful life for critical bonding is a minimum of 30 days. Once opened, the ambient useful life for bonding gages is 3 hours; if heated to 150°F, the useful life for bonding is five (5) minutes.

Precautions

- A separate set of tools are to be used for gaging with Epoxylite. Tools used to apply Silicone elastomer and other epoxies will contaminate the 6203 epoxy and change its bonding characteristics.
- The frozen epoxy must be allowed to warm to room temperature, 60°F - 80°F, for about 15 minutes prior to opening the tube. Before opening the tube, wipe the tube off with a clean, dry, lint free cloth. Any moisture which comes in contact with the epoxy will cause the bonding properties of the epoxy to degenerate.
- Adequate control to prevent confusion between new and used epoxy tubes is essential. After 4 hours, discard any opened tube.
- Do not use any materials such as Scotch tape, glass tape, etc. in the vacuum oven. These materials contain plasticizers and other solvents which will outgas and compromise the epoxy and contaminate the vacuum oven.

RECOMMENDED EQUIPMENT

- Tweezers, REM Model ASSAY or equivalent
- Vacuum Oven, capable of temperatures of 450°F.
- Petri Dish and cover

- Hot Plate, Miniature
- Microscope, Bausch & Lomb Model Stereo Zoom 4 or equivalent.
- Eyepiece, 10X, Bausch & Lomb, or equivalent.
- X-Acto Knife
- No. 000 red or white sable brush
- Glass slide
- Dental pick
- Epoxylite 6203FF
- Epoxy filtering screen
- Acetone, chemically pure

SURFACE PREPARATION

Sandblast the surfaces that are to be gaged with 50 - 100 μm aluminum oxide powder. This step is optional, but will result in a better bond between the surface and the epoxy.

Chemically clean the surfaces, that are to be gaged, with acetone. Dry thoroughly and verify that there is no lint or other residue left on the surface to be gaged. Repeat as necessary, using a microscope to verify that there is no residue left. If the part to be gaged cannot be used immediately, store it in a vacuum after the part has been cleaned.

BASE COAT APPLICATION

1. Set the hot plate at 110°F to 200°F.
2. Place the part, to be gaged, into an oven set at 200°F \pm 40°F for 1 hour.
3. Remove the part from the oven and place it on the hot plate. It may be necessary to hold the part to be gaged with a clamp, vise, etc.
4. Filter the epoxy through screen filter. All epoxy hereinafter referred to will be filtered epoxy.
5. Apply a thin coat of epoxy onto the surface to be gaged. Use either a No. 000 brush or dental pick.
6. Brush the epoxy to an even coat.
7. Avoid excessive brushing. The dimension of the base coat should be between 0.4 and 0.7 mils thick.
8. Cure the base coat for 15 to 30 minutes at 250°F \pm 10°F.
9. If the base coated transducers cannot be gaged within 8 hours, store them in an evacuated vacuum chamber at ambient temperature.

GAGE PREPARATION

1. Cut the gage leads at the label in the boxes.
2. Pick the gage up with the tweezers by one lead, approximately 1/32" from the actual gage.
3. Straighten this lead wire.
4. Trim the lead with an X-Acto Knife to a maximum length of 1/2".
5. Hold the gage with a pair of tweezers and slide a dental pick under the gage wire. Carefully bend the lead so that it is 90° to the top surface of the sensor.
6. The lead is to be straight and bent near the pad. The lead wires should be normal to the centerline of the sensor, starting 1/32" from the element.
7. Soak each gage in acetone for 15 - 30 seconds. Remove the gages from the acetone and dry the gages on a paper pad for 1 minute. If the gages are to be used at once, place them in order on a clean, dry paper pad.

Do not clean the gages until the parts are ready to have the gages installed. If a significant delay occurs, cleaned gages are to be stored in clean, covered Petri dishes in an evacuated vacuum oven.

GAGE INSTALLATION

Gages are to be installed only on bumpless blemish-free areas which are perfectly flat and which have an even precoat.

1. Place the part to be gaged on a hot plate, set at approximately 150° F . If the part to be gaged requires a holding fixture, such as a vise or a clamp, mount the part on the fixture before placing the part and the fixture on the hot plate.
2. Pick a gage and determine required location for that gage.
3. Using the tweezers, pick up the gage to be mounted by one of its leads as close as possible to the silicon without touching the silicon.
4. Apply 0.4 to 0.7 mils of epoxy to the bottom of the gage and immediately place the gage in its proper location. Orient the gages as necessary.
5. Using a microscope, check to ensure that a small fillet has formed around the periphery of the gage.
6. In situations where the end of a gage is to be mounted closer than 0.010” from a wall made of conducting material, a coat of epoxy must be applied to the wall in order to prevent the gage lead wire from shorting out .
7. Apply a coat of epoxy to all uncoated surface(s) over which the gage wire will be routed and to the area(s) where the solder tabs are to be located.
8. Cure the resultant gaged sensor according to the following cure schedule:
 - 12 hours at 200° F
 - 12 hours at 250° F
 - 12 hours at 300° F
 - 12 hours at 350° F
 - 12 hours at 400° F
 - 30 minutes at 425° F
 - Turn off oven and allow to cool *in vacuo* to ambient temperature.

In some instances, more than one surface will need to be gaged. However, only one surface is to be gaged at a time. The following sequence of gaging is to be used.

1. Base coat all gaging surfaces
2. Gage one surface at a time according to steps outlined above. Repeat until all surfaces needing gaging have been completed.

SOLDER TAB MOUNTING

Apply a small amount of 6203 epoxy on the areas to which the solder tabs are to be mounted. Note that it is not necessary to use screened epoxy in this step. Position the solder tabs as desired and cure for 2 hours \pm 30 minutes at 250°F \pm 10°F.

LEAD WIRES

1. Form the leads to the solder tabs as necessary and solder the leads to the solder tabs as appropriate.
2. If necessary, tack down the gage leads to the base coated areas using unfiltered 6203 epoxy.
3. Cure for 2 hours \pm 30 minutes at 250°F \pm 25°F.
4. Make insulation resistance and continuity tests. The insulation resistance of the bridge to the case ground must be greater than 50M Ω at 50 vdc. If the resistance is below 50M Ω , chemically clean the area, bake out, and recheck.

INSPECTION

The following are suggested criteria to be used for inspecting the gages after gaging has been completed

1. All gages shall have a fillet formed by epoxy around the sides of each gage. All gages should be checked for proper orientation according to the applicable drawing(s).
2. Gages which are mounted closer than 0.010" from a conducting wall will have an epoxy coating on the wall.
3. A top coat or over coat shall not be permitted on the top of the gages except in special applications (see above).
4. Spots of epoxy are permissible.

OTHER EPOXIES

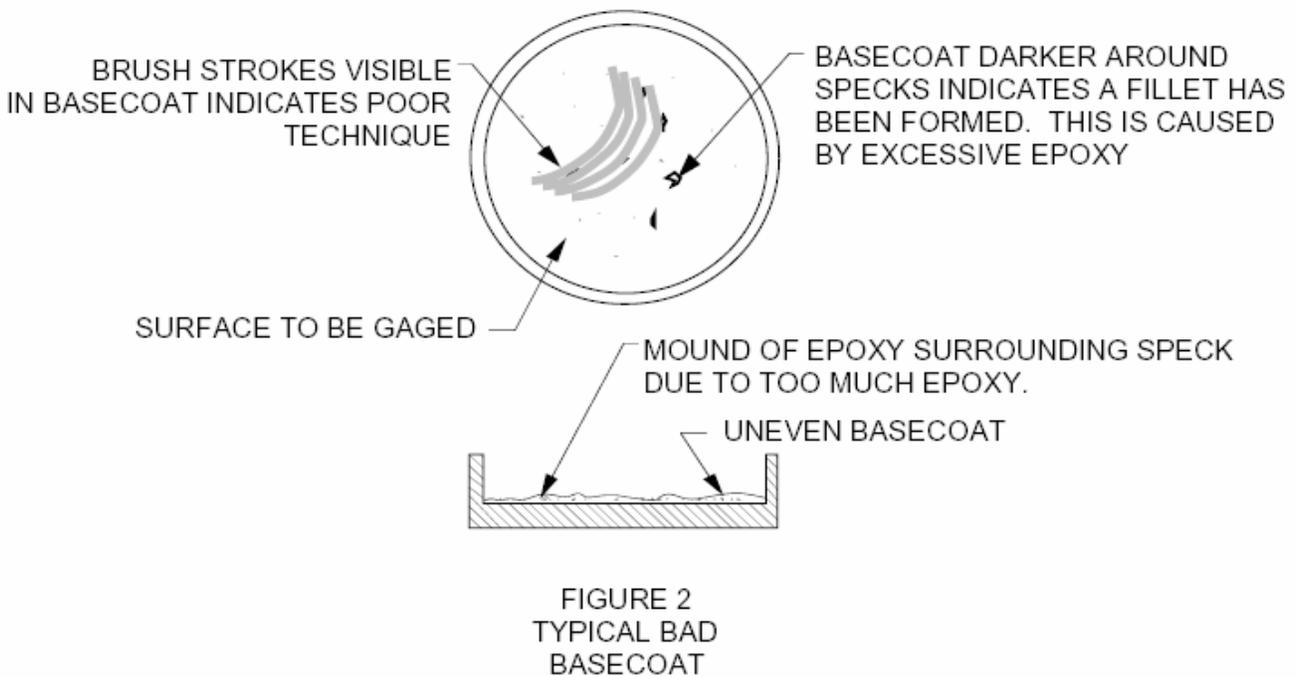
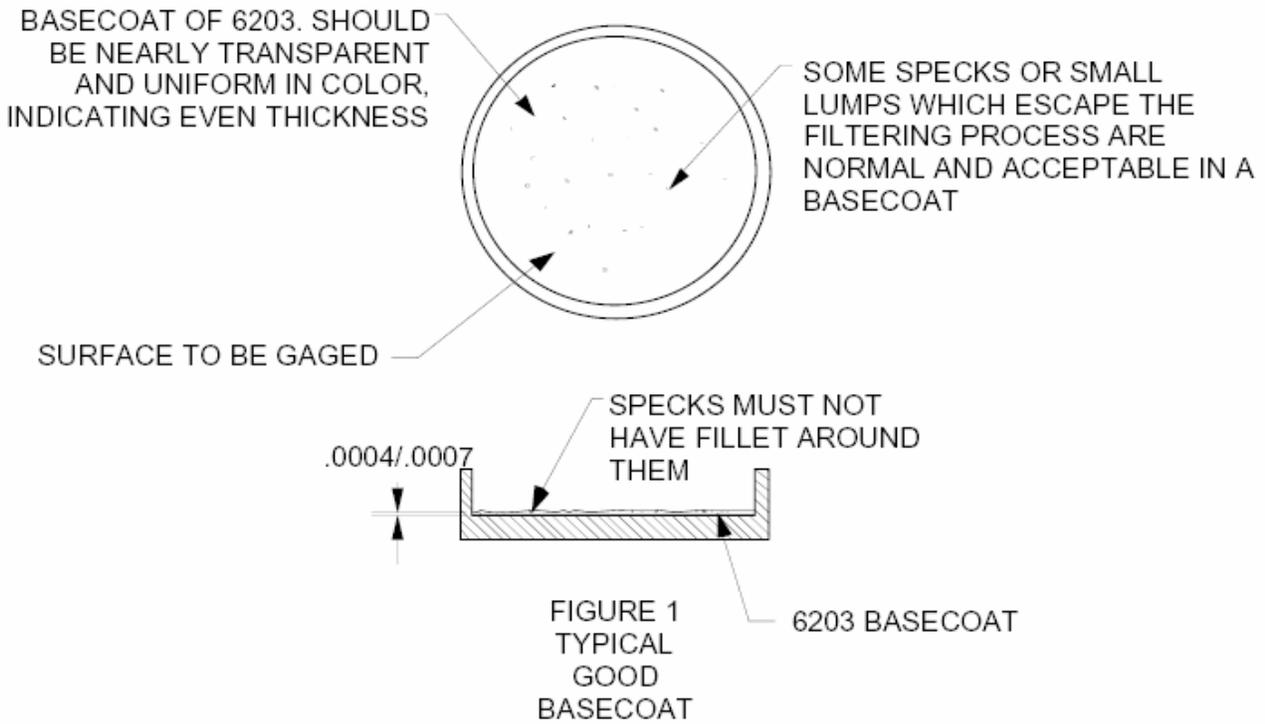
Other recommended epoxies are Micro Measurements M-Bond 610, Emerson and Cuming EC204, and EpoxyLite 6203 in a two-part kit.

The choice of adhesive is dictated primarily by the operating temperature of the installation.

Epoxy cements are available with cures ranging from 24 hours at room temperature to less than 1 hour at 350°F. The ultimate temperature and life of any organic cement is limited by oxidation and sublimation effects. M-Bond 610 is recommended for service to about 450°F, and EC-204 to about 350°F.

Instructions supplied by the manufacturer for mixing ingredients and selecting the appropriate curing cycle should be closely followed.

Each of the epoxies noted in this document are widely available through local distributors.



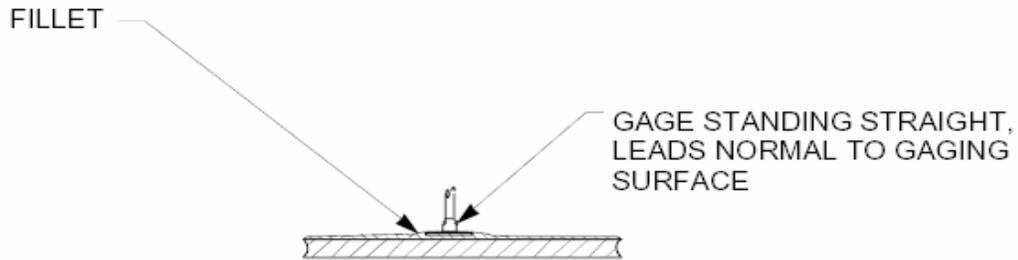
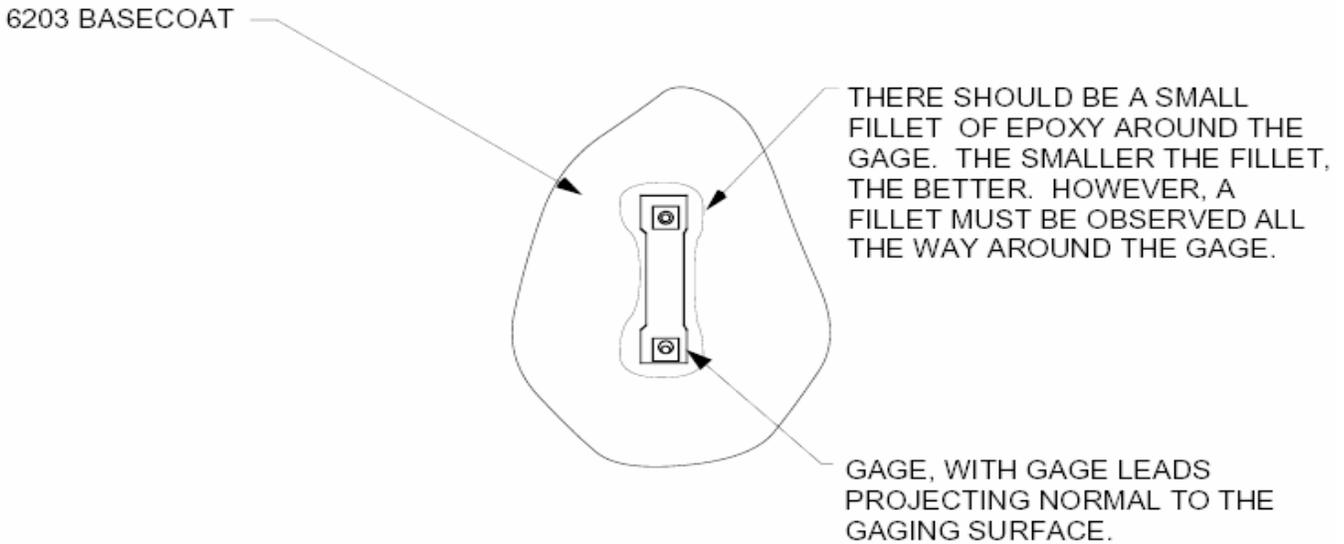
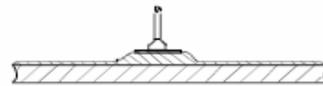


FIGURE 3
GOOD GAGE
CEMENTING



GAGE TILTED.
THIS COULD BE DUE TO TOO
MUCH EPOXY OR FROM A
PROJECTION FROM THE GAGING
SURFACE.



GAGE APPEARS TO BE
FLOATING ON A MOUND DUE
TO TOO MUCH EPOXY.
FILLET IS EXCESSIVELY
LARGE.

FIGURE 4
BAD GAGE
CEMENTING

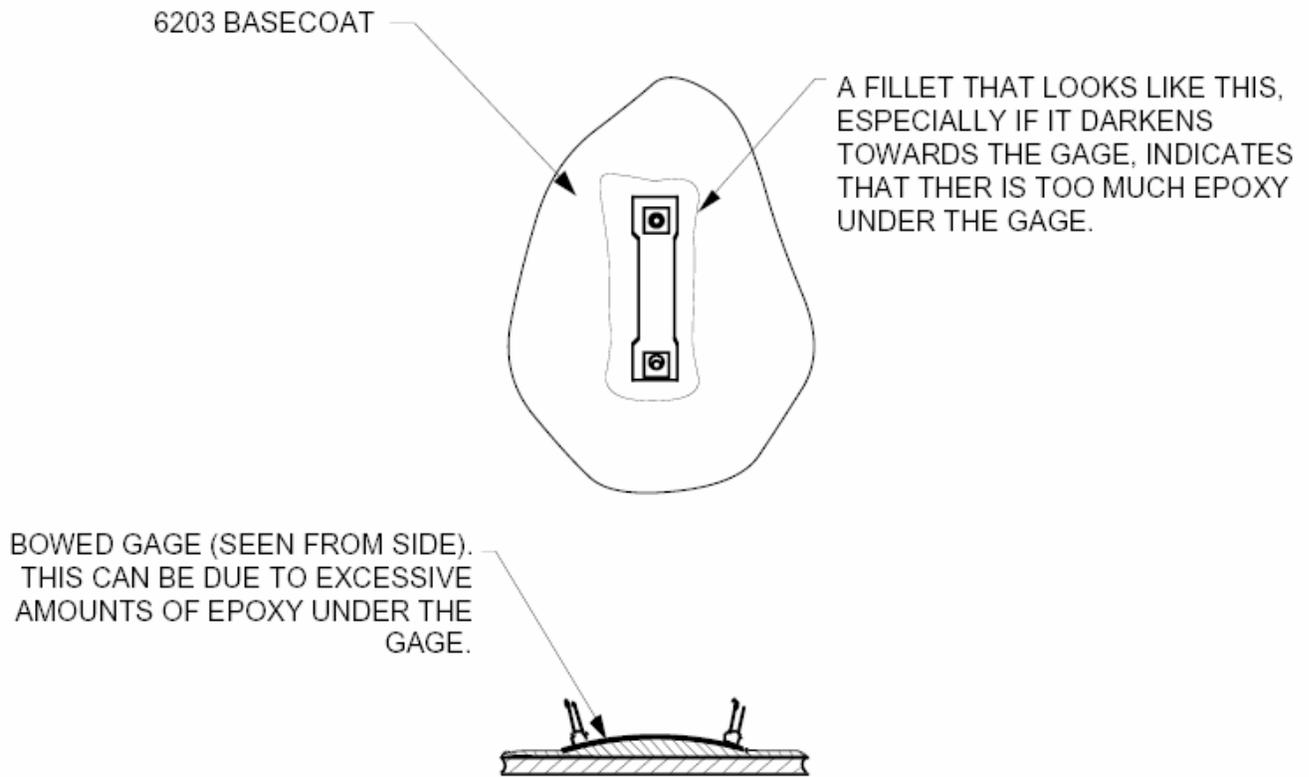


FIGURE 5
BAD GAGE
CEMENTING